

REMARKS

Claims 1-11, all the claims pending in the application, are rejected. Claim 1 is amended.
New claims 12-17 are added.

Support for Amendments

The amendment of claim 1 is clearly supported by the description of page 11, line 26 to page 12, line 3 of the original specification.

New claims 12 and 15 are clearly supported by the description of page 11, line 26 to page 12, line 3 of the original specification.

New claims 13 and 16 are clearly supported by the description of page 5, lines 6-9 and page 12, lines 22-26 of the original specification.

New claims 14 and 17 are clearly supported by the description of page 8, lines 11-13 and page 10, lines 24-25 of the original specification.

Claim Rejections - 35 USC § 103

Claims 1-2, 4-9, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hata (US 2002/0000424) in view of Kitano et al. (US 6,676,757). This rejection is traversed for at least the following reasons.

Amended Claim 1

Claim 1 has been amended to specify that the process includes (1) depositing a film of a resist liquid on a substrate by a spin-coating process, where “the spin-coating process includes a spin-drying process for preliminary-drying the film of the resist liquid by rotating the substrate, followed by (2) a reduced-pressure-drying process for the resist film deposited in the spin-coating process. The amendment is intended to specify that two separate drying processes are involved.

Hata

The Examiner asserts that “Hata discloses a method for manufacturing a mask blank by depositing a film of resist liquid on a substrate by a spin coating process, and thereafter covering the surface of the substrate with a covering member and performing removal by dissolving an unnecessary part of the resist film by supplying a solvent from above the covering member during

the rotation of the substrate and the covering member together so that the solvent is supplied to the periphery of the substrate. The Examiner admits that Hata does not teach spin drying, but asserts that “in the process of performing spinning to spread the coating to the outer periphery of the substrate, some drying of the applied liquid also occurs (“spin-drying”).” The Examiner also admits that “Hata lacks a teaching of performing a reduced-pressure drying process for the spin-coated resist film prior to performing the unnecessary-film-removing process, and looks to Kitano et al for such teaching.

Conventionally Drying Processes are Alternatives

As described in “Background Art” in the original specification, in case of a substrate for a mask blank, excellent uniformity in thickness of the resist film can be achieved by including only the spin-drying process in the spin-coating process. The spin-drying process is a process for preliminarily drying the resist film under a predetermined condition. In case of a large-sized substrate, only the reduced-pressure-drying process is carried out as preliminary-drying in order to suppress the flow of the resist. Thus, conventionally, it is sufficient to perform either one of the spin-drying process and the reduced-pressure-drying process. Economics and efficiencies strongly mitigate against using both types of processes in the same production line.

Newly Identified Problem With Unnecessary Film Coating

Given this background, the inventor of the present invention first found as a problem in the method for removing an unnecessary film disclosed in Hata that, temperature distribution occurs such that the central part of the cover member has a relatively high temperature and the temperature is gradually lowered towards the periphery of the cover member. When the unnecessary film is removed while the substrate is rotated, the resist is caused to flow under the influence of (1) the temperature distribution and/or (2) the centrifugal force to cause local variation in film thickness. This results in degradation of uniformity of the in-plane film thickness (see page 3, line 20 to page 4, line 9 of the instant specification).

Two Stage Drying Process Provides a Unique Solution

The present invention comprises the following steps:

(1) to form a resist film by the spin-coating process including the spin-drying process (preliminary-drying);

(2) to perform the reduced-pressure-drying process; and

(3) to remove the unnecessary part of the film.

By the above-mentioned two-stage drying process, even if the unnecessary film is removed by using the cover member, it is possible to suppress the flow of the resist under the influence of the temperature distribution or the centrifugal force and to improve the uniformity of the in-plane film thickness of the resist film.

Hata Does Not Solve the Problem

In the method disclosed in Hata, the unnecessary part of the film is dissolved and removed by the solvent supplied through the solvent supply hole while the substrate and the cover member are rotated together. As admitted by the Examiner, Hata does not disclose the reduced-pressure-drying process of the present invention. Further, Hata does not disclose the spin-drying process of the present invention. Thus, Hata neither discloses nor suggests the two-stage drying process and the above-mentioned problems described in the present application.

Kitano

Kitano Does Not Suggest the Solution

Kitano addresses the problem that, when the resist solution is applied to the substrate by the spin-coating process, the uniformity of the in-plane film thickness is degraded if the film thickness is small. In view of this problem, Kitano aims to provide an apparatus for achieving a technique to be used in place of the spin-coating process.

As a technique to be used in place of the spin-coating process, the resist solution is supplied to the wafer in a manner so-called "single stroke writing" shown in FIG. 34. In this manner, the disadvantage resulting from the rotation of the wafer is avoided. However, use of the "single stroke writing" causes another problem. That is, in the "single stroke writing", even if the resist solution is uniformly applied, a substantially 100% of the thinner remains. Therefore, it requires a long time to volatilize the thinner. The amount of volatilization varies within the wafer surface since it is difficult to uniformly conduct heat to the resist solution. This results in a

problem that the obtained film is degraded in uniformity of the film thickness (see column 1, line 31 to column 2, line 13). In order to solve the above-mentioned problem, in the "single stroke writing", the substrate coated with the coating solution is dried under the reduced pressure.

No Basis for Combining Hata and Kitano

Applicants respectfully submit that there are significant barriers to the combination of Hata and Kitano. In light of those barriers, the present invention would not be taught or suggested from even in combination of these references, for the reasons given below.

First, in order to meet the recently increasing demand for miniaturization of the pattern, Kitano expressly rejects the use of the spin-coating process. On the other hand, Hata discloses it is necessary to remove the coating fluid remaining in the peripheral region when the spin-coating process is used. Accordingly, in view of the teachings away from their combination and the inherent technical incompatibilities, one skilled in the art would not think to combine these references.

Second, Kitano uses the reduced-pressure-drying process in order to avoid the problem caused by the fact that a substantially 100% of the thinner remains, which problem is first caused by the technique used instead of the spin-coating process as described above. On the other hand, in the present invention, the spin-drying process is already performed and a substantially 100% of the thinner is not left. In the present invention, based on the finding that, upon carrying out the method of removing the unnecessary film by using the cover member, there arises a problem that the resist flows under the influence of the temperature distribution or the centrifugal force and resultant local variation in film thickness degrades the uniformity of in-plane film thickness, the reduced-pressure-drying process is performed.

Third, Hata and Kitano neither disclose nor suggest the claimed spin-drying process. Further, Kitano rejects the spin-coating process and, therefore, the spin-drying process can not be envisaged from its teachings. In Kitano, the resist film is dried by the reduced-pressure-drying process and, therefore, a two-stage drying process is neither needed nor practical and would not be considered by one skilled in the art.

On the basis of the foregoing, amended independent claim 1 is not obvious to one having ordinary skill in the art.

Claims 1, 2, 4-9 and 11

On the basis of their dependency from patentable claim 1, the dependent claims are not obvious to one having ordinary skill in the art.

Claims 3 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hata (US 2002/0000424) in view of Kitano et al. (US 6,676,757) and further in view of Okada (U.S. 4,748,753). This rejection is traversed for at least the following reasons.

Okada

Okada relates to the spin-coating process. For all of the reasons given for the incompatibility of Hata and Kitano, Okada would not be combinable with Kitano.

Thus, all of the pending claims, as now amended, would be patentable over the combination of references, including Hata, Kitano and Okada.

New Claims

The new claims 12-17 depend from patentable claim 1 and would be patentable for the same reasons.

On the basis of the foregoing, the amended and new independent claims are not obvious to one having ordinary skill in the art. Moreover, the dependent claims are not obvious to one having ordinary skill in the art, at least because of their dependency from patentable parent claims.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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Date: September 23, 2009